Biochimica et Biophysica Acta 1832 (2013) 1910–1912

Contents lists available at SciVerse ScienceDirect

Biochimica et Biophysica Acta

journal homepage: www.elsevier.com/locate/bbadis

Funding resources for rare disease research ☆

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ARTICLE INFO

Article history:
Received 15 October 2012
Received in revised form 29 January 2013
Accepted 12 April 2013
Available online 19 April 2013

Keywords:
Funding
Rare disease
Neuronal Ceroid Lipofuscinosis
Batten disease
Lysosomal storage disease
Orphan disease

ABSTRACT

Research is an expensive venture requiring multiple sources of funding for small projects that test new theories, large projects to make major advancements, training the next generation of researchers and facilitating meetings to share findings and support collaboration. For rare conditions, such as Batten disease, research funds can be difficult to find.

To see how investigators supported their work in the past, we did a key word search of the Acknowledgement Section of peer-reviewed literature published in Batten disease in the last 6.5 years. Interestingly, we discovered 193 separate funding sources. The authors hope that, by showing where funds are available, we will enable Batten disease researchers to continue their pursuits and expand their studies; moving key findings from discovery to application phases. This article is part of a Special Issue entitled: The Neuronal Ceroid Lipofuscinoses or Batten Disease.

1. Introduction

Funding for scientific research typically comes from three main sources: government agencies, such as the US National Institutes of Health (NIH), pharmaceutical companies, and private funders including family foundations, charities, and philanthropists. It is estimated that federal governments provide 30% of all medical research funding concentrating on basic research and scholarly pursuit. Pharmaceutical and Biotechnology for-profit companies are responsible for 60–65% of research funding. These industries invest in basic discovery but focus the bulk of their efforts on transitioning their own discoveries and those funded by federal governments into applied medicines. Private funding constitutes less than 5% of overall research spending. However, private funders are in a unique position to fill funding gaps and advance therapy. Because of their focus on identifying, prioritizing, and shepherding translatable discoveries, the National Multiple Sclerosis Society (NMSS) has played a pivotal role in bringing MS drugs to market and the Michael J Fox Foundation (MJFF) has supported 51 clinical trials in the Parkinson disease field. By supporting innovative pilot studies, investing in proof-of-principal/early failure studies in drug discovery, educating their patient communities, and developing centralized registries, these trailblazers have set the stage for smaller nonprofits to follow suit strategically placing their funds where they are needed the most.

For legislative decision makers, clinicians, and research scientists, rare or "orphan" diseases are defined as any disease that affects a very small percentage of the population. For families affected by these diseases, "rare" refers to a disease in which very little academic research takes place and has not been adopted by the pharmaceutical industry because it offers little financial incentive to make and market drugs to treat and prevent it. With a prevalence rate of 1.2 per 100,000 live births, Batten disease (also known as Neuronal Ceroid Lipofuscinosis) falls well within the definition of a rare disease in Europe (less than 5 in 10,000). In the USA according to the Rare Disease Act of 2002 an orphan disease is defined as one that affects less than 200,000 persons, which is about 1 in 1500 people [1]. In total approximately 6000–8000 rare diseases are known. Batten disease, by any definition, is rare. The National Institutes of Health in the United States dedicated .001% of its budget to all forms of Batten disease. The European Union funded fewer proposals. Less than five pharmaceutical companies have invested in 2 forms of Batten disease.

Nonprofit Batten disease foundations and charities have attempted to fill this gap by establishing fellowships to train new investigators, providing high-risk pilot grants to test novel ideas, and investing in disease-specific resources such as cell lines and animal models. If passion was equal to money, we would be rich in every sense of the word. Unfortunately, this is not the case. Research is expensive and private funding accounts for less that 5% of the total investment in medical research highlighting what an uphill battle rare disease foundations face.

This article carefully examines the Batten disease funding landscape. The authors hope that, by showing where funds are available, we will

Abbreviations: NCL, Neuronal Ceroid Lipofuscinosis; JNCL, Juvenile Neuronal Ceroid Lipofuscinosis; NIH, National Institutes of Health; BDSRA, Batten Disease Support and Research Association; BDFA, Batten Disease Family Association

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http://dx.doi.org/10.1016/j.bbadis.2013.04.016

enable Batten disease researchers to continue their pursuits and expand their studies, moving key findings from discovery to application phases.

2. Methods

2.1. Batten disease literature online search

For addressing the question which agencies fund specifically Batten disease research we conducted a literature search via PubMed (www.ncbi.nlm.nih.gov/pubmed/) using the key words "Ceroid", "Batten", "Battenin", or "Btn1" in the title as well as the abstract. The publication dates were limited to January, 2006 and June, 2012. Each result was analyzed for its relevance to Batten disease. Subsequently the "funding" or "Acknowledgement" sections (depending on the journal) of these articles were analyzed in order to set up a list of funding agencies. The mentioned agencies were searched on the web and categorized by the type of organization they belong to.

3. Results

3.1. Batten disease literature online search

By using different key words relevant to Batten disease we identified 449 articles listed in PubMed between January, 2006 and June, 2012. We identified between 37 and 57 publications per year (2006–2011: average 48 SN +/− 6). Manual examination of each abstract, revealed 298 publications relevant to Batten disease. False positives were generated e.g. by articles dealing with the Hermansky Pudlak Syndrome (13 articles), "Batten grafts" (28 articles) or "ceroid" (62 articles) — a component of accumulated storage material found in age-related macular degeneration as well as Batten disease. Of the 298 Batten disease publications 236 were analyzed for references to funding sources. The remaining publications (62) did not mention any funding resources (55), did not have an "Acknowledgement" section (4), or were not accessible to the authors (3).

We identified 193 different funding agencies that supported Batten disease research (Fig. 1). 39% were non-profit organizations. An equal number of public funders were found. This category includes national as well as international programs. The level of funding is not mentioned in publications.

This study is limited to the choice of key words that have been used. In addition, the outcome only shows agencies that funded Batten disease research which led to a peer-reviewed publication. Other data bases – e.g. patent data bases and commercial product announcements – were not included but could contribute to a higher number of publications. It is unclear whether these or other publications would cite funding sources.

54% (109) of the acknowledged funding sources were mentioned in one article, suggesting that their investment in Batten disease research was a one-time investment or indirect (Supplementary material). The NIH and Batten Disease Support and Research Association (BDSRA) were the most acknowledged funding sources, cited 103 and 88 times respectively, followed by the Wellcome Trust and Batten Disease Family Association (BDFA) (25 and 22 times respectively). In 165 out of 236 articles (~70%) at least one non-profit organization was mentioned among the funding agencies emphasizing the financial contribution of this category.

In more than 80% of 236 Batten disease publications at least two different funding resources were mentioned (Fig. 2). This means that researchers depend on multiple funding resources. This could be due to the fact that research projects are accomplished by teams of researchers with different funding needs spanning laboratories and universities plus the high cost of research.

Examining the geographical location of corresponding authors suggested that nearly 50% of Batten disease research was led by investigators in US-based institutions (Fig. 3). The second highest score, from 295 papers reviewed, showed active research programs in Finland where the carrier frequency of mutated Batten disease alleles is much higher than the known world average. In total, peer-reviewed research was conducted by investigators in 31 countries.

4. Discussion

Without attaching funding levels to various sources or being able to ensure the accuracy of each acknowledgement section, it is impossible to draw solid conclusions from this data other than several funding sources used to complete published research in the 6.5 years we looked at. While the ratio of federal to private funding appears near-equal, again the amounts are unknown. Future directions may include assigning funding levels. However, these numbers can be quite volatile as availability of funds changes rapidly, especially in the nonprofit sector which is highly dependent upon local economies. Therefore, researchers and students should be encouraged to engage the services of an online editorially-reviewed and well-maintained medical research database network such as Community of Science (COS), now owned by ProQuest. COS and other networks as such, allow one to save searches, track specific opportunities, and create personal deadlines. Duke University hosts a website (https://researchfunding.duke.edu/) helping university-based investigators access funding opportunities from around the world as well as local opportunities created by state funding agencies and local supporters. Many large universities also have dedicated staff to match opportunities to their investigators. The ELectronic Research Funding Information System (ELFI) www.elfi.info/index.php posts funding opportunities for rare disease research in German speaking regions. It provides a well-kept collection of public and private funding options including short descriptions. Furthermore, the German website "Forschen–Foerdern" (www.forschen-foerdern.org/en) provides a good overview about research awards and research programs. Another website that might be of interest is hosted by

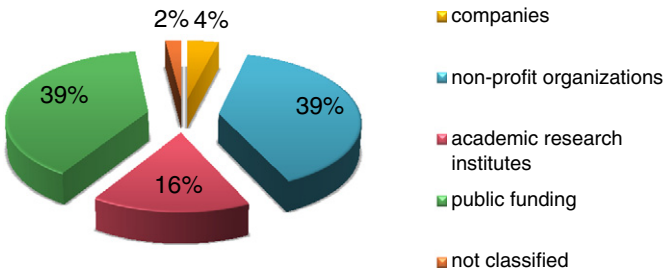

Fig. 1. Categorization of 193 funding sources found in 236 articles.

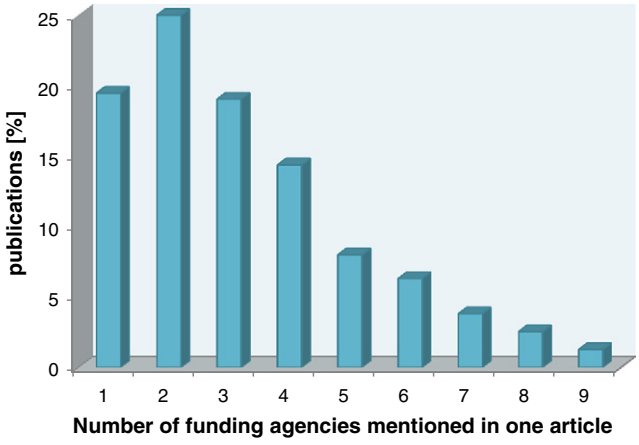

Fig. 2. Number of funding institutions mentioned in a single article.

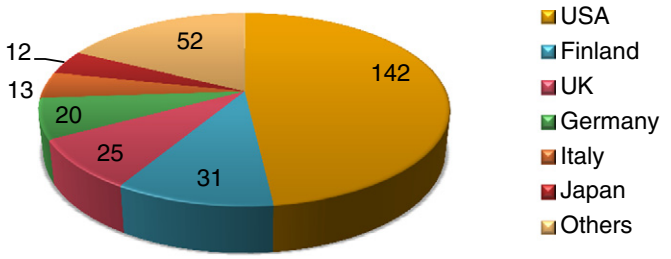

Fig. 3. Number of Batten disease articles published per country (01/2006–06/2012). "Others": number of publications equal or less than 10 per country. It includes 25 different countries.

EURORDIS (http://raretogether.eurordis.org/category/mentoring-topics/funding/resources/).

Funding opportunities can be very specific. Examples include stipends for time spent writing medical education books, grants for women returning to research after raising their families, or support for members of particular religious groups. Researchers can maximize their search for funds by informing their development office of exactly what it is that they do.

Most non-profit organizations that fund research have strict regulations. Most are disease or population specific (e.g. Blackswan Foundation, rare disease). Many have citizenship requirements preferring to support their own country's research needs. Some focus on the research needs of a particular institution developing a more intimate relationship with the needs of a single community.

With the advent of advanced communication systems, the field of research and associated nonprofits has gone global and it is much easier for a nonprofit to act worldwide. BDSRA and Bee for Battens fund NCL projects across the globe. NCL-Stiftung and Beyond Batten Disease Foundation do the same for juvenile NCL.

5. Conclusion

We identified 193 different funding agencies that supported Batten disease research. 39% were non-profit organizations. An equal number of public funders were found. The numbers of government-supported funding sources and nonprofit private funds were approximately equal. The NIH and BDSRA were the most frequent funders followed by the Wellcome Trust and BDFA. Approximately 70% of articles cited receiving funding from at least one non-profit organization. Over 80% of articles cited at least two different funding resources. Almost 50% of all published articles have a corresponding author in the United States, followed by researchers in Finland. In total, publications were produced by investigators from 31 countries. In conclusion, advancements in Batten disease research have required multiple funders willing to make investments in laboratories across the globe. Affected families play a major role in research not only by raising many of the nonprofit funds that have been used but also by raising awareness, advocating for increased government spending, motivating researchers, providing valuable medical histories and submitting precious resource material ultimately placing their trust in the research and healthcare community to change their future.

Conflict of interest

The authors declare that there are no conflicts of interest.

Acknowledgements

We wish to thank the consultancy Booz&Co. for their honorary and professional support. We are also very thankful for the invaluable input from Danielle Kerkovich.

Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.bbadis.2013.04.016.

Reference

[1] A. Lavandeira, Orphan drugs: legal aspects, current situation, Haemophilia 8 (3) (2002).